

WHAT IS CLAIMED IS:

1. An article of manufacture comprising an optical-ready substrate made at least in part of a first semiconductor material and having a front side and a backside, said front side having a top surface that is of sufficient quality to permit microelectronic circuitry to be fabricated thereon using semiconductor fabrication processing techniques, said optical-ready substrate including an optical signal distribution circuit fabricated on the front side of the substrate in a first layer region beneath the top surface of the substrate, said optical signal distribution circuit made up of interconnected semiconductor photonic elements and designed to provide signals to the microelectronic circuitry to be fabricated thereon.

2. The article of manufacture of claim 1 wherein the first layer region has a surface that defines said top surface of the optical-ready substrate.

3. The article of manufacture of claim 2 wherein the semiconductor photonic elements of the optical distribution circuit include optical waveguides and output elements coupled to the optical waveguides for delivering signals carried by the waveguides to the microelectronic circuitry.

4. The article of manufacture of claim 3 wherein said output elements are optical detectors which convert optical signals to electrical signals.

5. The article of manufacture of claim 3 wherein said output elements are optical elements that function to redirect light signals traveling within the waveguides upward toward the top surface of the semiconductor substrate.

6. The article of manufacture of claim 2 wherein the optical distribution circuit further comprises optical input elements that function to couple incoming optical signals into the optical distribution circuit.

7. The article of manufacture of claim 2 wherein said output elements include at least one of a semiconductor element that functions to direct optical signals from the optical

3 waveguides up toward the top surface and a semiconductor element that functions to convert the
4 optical signals distributed by the optical waveguides to electrical signals.

1 8. The article of manufacture of claim 2 wherein the optical signal distribution circuit is
2 an optical clock signal distribution network.

1 9. The article of manufacture of claim 2 wherein the first semiconductor material is
2 silicon.

1 10. The article of manufacture of claim 1 wherein the optical-ready substrate comprises a
2 carrier substrate that is made at least in part of the first semiconductor material and a layer of
3 second semiconductor material on top of and defining an interface with the carrier substrate, and
4 wherein said optical signal distribution circuit is fabricated in the carrier substrate at the interface
5 between the carrier substrate and the second semiconductor layer and wherein the layer of
6 second semiconductor material defines the top surface of the optical-ready substrate.

1 11. The article of manufacture of claim 10 wherein the semiconductor photonic elements
2 of the optical distribution circuit include optical waveguides and output elements coupled to the
3 optical waveguides for delivering signals carried by the waveguides to the microelectronic
4 circuitry.

1 12. The article of manufacture of claim 11 wherein said output elements are optical
2 detectors which convert optical signals to electrical signals.

1 13. The article of manufacture of claim 11 wherein said output elements are optical
2 elements that function to redirect light signals traveling within the waveguides upward toward
3 the top surface of the semiconductor substrate.

1 14. The article of manufacture of claim 10 wherein the optical distribution circuit further
2 comprises optical input elements that function to couple incoming optical signals into the optical
3 distribution circuit.

1 15. The article of manufacture of claim 10 wherein said output elements include at least
2 one of a semiconductor element that functions to direct optical signals from the optical

3 waveguides up toward the top surface and a semiconductor element that functions to convert the
4 optical signals distributed by the optical waveguides to electrical signals.

1 16. The article of manufacture of claim 10 wherein the optical signal distribution circuit
2 is an optical clock signal distribution network.

1 17. The article of manufacture of claim 10 wherein the first semiconductor material is
2 silicon.

1 18. The article of manufacture of claim 10 wherein the second semiconductor material is
2 silicon.

1 19. The article of manufacture of claim 1 wherein the optical-ready substrate comprises a
2 carrier substrate, an insulator layer on top of the carrier substrate, and a layer of second
3 semiconductor material on top of the insulator layer, and wherein said optical signal distribution
4 circuit is fabricated in the carrier substrate immediately below the insulator layer and wherein the
5 layer of second semiconductor material defines the top surface of the optical-ready substrate.

1 20. The article of manufacture of claim 19 wherein the semiconductor photonic elements
2 of the optical distribution circuit include optical waveguides and output elements coupled to the
3 optical waveguides for delivering signals carried by the waveguides to the microelectronic
4 circuitry.

1 21. The article of manufacture of claim 20 wherein said output elements are optical
2 detectors which convert optical signals to electrical signals.

1 22. The article of manufacture of claim 20 wherein said output elements are optical
2 elements that function to redirect light signals traveling within the waveguides upward toward
3 the top surface of the semiconductor substrate.

1 23. The article of manufacture of claim 19 wherein the optical distribution circuit further
2 comprises optical input elements that function to couple incoming optical signals into the optical
3 distribution circuit.

1 24. The article of manufacture of claim 19 wherein said output elements include at least
2 one of a semiconductor element that functions to direct optical signals from the optical
3 waveguides up toward the top surface and a semiconductor element that functions to convert the
4 optical signals distributed by the optical waveguides to electrical signals.

1 25. The article of manufacture of claim 19 wherein the optical signal distribution circuit
2 is an optical clock signal distribution network.

1 26. The article of manufacture of claim 19 wherein the first semiconductor material is
2 silicon.

1 27. The article of manufacture of claim 19 wherein the second semiconductor material is
2 silicon.

1 28. The article of manufacture of claim 19 wherein the insulator is made of SiO₂.

1 29. An article of manufacture comprising an optical-ready substrate including a carrier
2 substrate made at least in part of a first semiconductor material, an insulator layer on top of the
3 carrier substrate, and a layer of second semiconductor material on top of the insulator layer, said
4 layer of second semiconductor material defining a top surface that is of sufficient quality to
5 permit microelectronic circuitry to be fabricated thereon using semiconductor fabrication
6 processing techniques, said optical-ready substrate also including an optical signal distribution
7 circuit fabricated in the carrier substrate immediately below the insulator layer, said optical
8 signal distribution circuit made up of interconnected semiconductor photonic elements and
9 designed to provide signals to the microelectronic circuitry to be fabricated thereon.

1 30. The article of manufacture of claim 29 wherein the first and second semiconductor
2 materials are silicon and wherein the insulator is made of SiO₂.

1 31. The article of manufacture of claim 29 wherein the optical signal distribution circuit
2 is an optical clock signal distribution network.

1 32. A method of producing an optical-ready substrate on which microelectronic circuitry
2 can later be fabricated, said method comprising:

3 by using a first set of semiconductor processes, fabricating an optical-ready
4 semiconductor substrate; and
5 sending the optical-ready substrate to a purchaser that will subsequently fabricate
6 microelectronic circuitry thereon by using a second set of semiconductor processes.

1 33. The method of claim 32 wherein the fabricating comprises:
2 providing a carrier substrate made at least in part of a first semiconductor material and
3 having a front side and a backside,
4 by using the first set of semiconductor fabrication processes, fabricating optical signal
5 circuitry on the front side of the carrier substrate, said optical signal circuitry made up of
6 interconnected semiconductor photonic elements and designed to provide signals to the
7 microelectronic circuitry to be fabricated thereon at a later time; and
8 creating a top surface above the optical signal circuitry that is of sufficient quality to
9 permit the microelectronic circuitry to be fabricated thereon using a second set of semiconductor
10 fabrication processes.

1 34. The method of claim 33 wherein the step of fabricating the optical signal circuitry
2 comprises fabricating an optical clock signal distribution network.

1 35. The method of claim 33 wherein the step of creating involves fabricating an SOI
2 structure.

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